NOTICE

THE LIBRARY OF THE
SEP 24 1930
UNIVERSITY OF ILLINOIS.

OF THE

TWO MASSES OF METEORIC IRON

BROUGHT FROM

TUCSON TO SAN FRANCISCO, 1862 AND 1863.

BY J. D. WHITNEY.

SAN FRANCISCO:
PRINTED BY TOWNE & BACON, BOOK AND JOB PRINTERS,
No. 536 Clay Street, opposite Leidesdorff.
1863.

552.6
W61

NOTICE OF THE TWO MASSES OF METEORIC IRON

BROUGHT FROM TUCSON TO SAN FRANCISCO 1862 AND 1863.

[From the Proceedings of the California Academy of Natural Sciences, Vol. III, page 30.]

Professor Whitney communicated the following letter from Professor Brush, giving the results of a chemical investigation of the meteoric iron presented to the city of San Francisco, by General Carleton:

SHEFFIELD LABORATORY OF YALE COLLEGE,
NEW HAVEN, March 30th, 1863.

Professor J. D. Whitney, State Geologist, San Francisco, Cal.

DEAR SIR :—I have examined the specimen of meteoric iron from Tucson, which you sent me for analysis, and herewith communicate to you my results.

The density of the mass is 7.29. When a fragment of it is placed in a solution of neutral sulphate of copper, it quickly becomes coated with metallic copper, proving the iron to be "active." An inspection of the specimen with a lens showed it to be dotted with little cavities, which on the fresh fracture were lined with a white silicious mineral, giving the surface a porphyritic, or pseudo-porphyritic, appearance.

When a fragment was attacked with an acid, a portion of the iron was dissolved, leaving the silicious mineral projecting from the surface of the specimen; and with a magnifier, black particles of Schreibersite could be seen. After complete solution of the iron, a careful microscopic examination was made of the insoluble residue. With a magnifying power of 25 diameters, it appeared to consist chiefly of two substances: one a milk-white to transparent mineral, having a fused, rounded surface, occurring in little globules, or elongated, rounded particles; while the other constituent was black and angular, and attractable by the magnet. The first named substance, when observed with a magnifying power of 100 diameters, proved to contain minute specks of the black mineral disseminated through it; some of the silicious fragments were translucent and of a milk-white color, and others colorless and transparent; a large number, however, were transparent at one end, shading into milk-white at the other, thus seeming to indicate that the transparent and translucent portions were not two

741372

distinct minerals. A blowpipe examination of the silicious mineral showed it to have characters very much resembling *olivine.* The black mineral proved to be *Schreibersite.* A minute trace of chromium was also observed in the insoluble residue.

The qualitative analysis of the portion soluble in nitric acid indicated the presence of iron, nickel, cobalt, copper, phosphorus, lime, and magnesia with unweighable traces of chlorine, sulphur, and alumina. For the quantitative examination of the meteorite a fragment weighing 4.3767 grammes was treated with nitro-chlorohydric acid (aqua regia), and after solution of the iron the whole was evaporated; on approaching dryness, gelatinous silica separated, showing that the silicate had been partially, at least, decomposed by the acid. After heating until the silica was rendered insoluble, it was repeatedly treated with acid and evaporated, so as to insure the oxydation of all the Schreibersite, and finally the soluble part was taken up with chlorohydric acid, and on dilution separated by filtration from the silica and insoluble residue.

The filtrate, or *soluble* part, was accurately measured and divided into four portions for analysis—two portions were used for the determination of the iron, nickel, cobalt, phosphorus, and alkaline earths; a third portion was employed to estimate the copper, and the fourth portion was reserved to answer in case of accident.

Two methods were used for the separation of the iron from the nickel and cobalt—one by precipitation of the iron as basic acetate, and the other by precipitation with carbonate of baryta in the presence of an excess of chloride of ammonium; but in neither case was the separation perfected on the first precipitation, and traces of nickel remained with the iron even after the second precipitation. The nickel and cobalt were separated by means of nitrite of potash, and the cobalt was subsequently converted into sulphate and as such weighed. The lime and magnesia were separated by oxalate of ammonia, care being taken to redissolve and reprecipitate the lime to insure its being free from traces of magnesia. On spectroscopic examination of the precipitate, it proved to be lime, free from other alkaline earths.

The precipitate of iron, after being weighed, was fused with carbonate of soda; the product of the fusion was dissolved in chlorohydric acid, and the phosphoric acid precipitated with molybdate of ammonia. This phospho-molybdic precipitate was dissolved in ammonia to free it from possible traces of silica and other impurities, and the phosphoric acid precipitated from this solution by an ammoniacal mixture of sulphate of magnesia and chloride of ammonium.

The copper was precipitated as sulphide by sulphuretted hydrogen gas, redissolved in nitric acid, and determined as oxyd.

The *insoluble residue*, containing free silica and undecomposed silicate, was perfectly white, and free from all traces of Schreibersite. It weighed 0.1855 grm. equal to 4.24 per cent. of the specimen analyzed. It was fused with carbonate of soda, and the silica and bases determined in the usual manner. It contained 0.159 grm. silica; 0.0054 protoxyd of iron, with a minute trace of alumina; 0.0028 lime, and 0.0168 magnesia.

The soluble and insoluble portions gave in the analysis the following per centage composition :

		Considering the silica to exist as olivine.	
Iron	81.56		79.44
Nickel	9.17		9.17
Cobalt	0.44		0.44
Copper	0.08		0.08
Phosphorus	0.49		0.49
Silica	3.63	Combined with 2.73 Protoxyd of Iron, making Olivine ..	10.07
Protoxyd of Iron with trace of Alumina	0.12		
Lime	1.16		
Magnesia	2.43		
Chlorine, Sulphur, Chromium,	minute traces		traces.
	99.08		99.69

If the silica found in this analysis be considered to exist in combination with lime, magnesia, and iron, in the proportions to form olivine, it will be necessary to deduct 2.12 per cent. from the amount of metallic iron (equal to 2.73 per cent. of protoxyd of iron), in order to give the silicate the olivine formula, (3 R O, Si O_3). Admitting this to be the correct view, the mass analyzed contains 10.07 per cent. of olivine, and by the addition of the oxygen of the protoxyd of iron the analysis adds up 99.69 instead of 99.08.

The variable composition of Schreibersite in different specimens of meteoric iron, and the peculiar character of the insoluble residue of this meteorite, together with the small amount of material in my possession, rendered it impracticable to determine the exact amount of this substance contained in the specimen.

The composition of this meteorite corresponds very closely with another meteoric-iron from Tucson, discovered by Mr. Bartlett, and described by Prof. J. Lawrence Smith, in the *American Journal of Science*, vol. XIX, page 161. Dr. Smith's analysis gives Iron 85.54, Nickel 8.55, Cobalt 0.61, Copper 0.03, Phosphorus 0.12, Chromic-oxyd 0.21, Magnesia 2.04, Silica 3.02, Alumina, trace=100.18. He considers it to correspond to Nickeliferous Iron 93.81, Chrome Iron 0.41, Schreibersite 0.84, Olivine 5.06=100.18. By an evident inadvertence Dr. Smith adds the magnesia and silica together, and gives the sum as olivine ; these substances are obviously not in the proportions to form the silicate 3 R O, Si O_3, and if we consider the silicate to be olivine, we must reckon the excess of silica as combined with protoxyd of iron. To do this, we must deduct 2.78 from the amount of metallic iron (equal to 2.58 protoxyd of iron), necessary to be combined with the silica and magnesia to give the olivine formula. The amount of olivine contained in the Bartlett meteoric-iron will then be 8.64 per cent. Thus the two masses of iron will be seen to agree very nearly in composition, the only trifling difference being, that Dr. Smith has determined quantitatively the small amount of chromium contained in the Bartlett meteorite, while I have found a little lime and traces of sulphur and chlorine in the specimen you sent to me. The specific gravity I have stated to be 7.39; this was taken on about 12.5 grammes of the iron, and probably is somewhat higher than the portion which I analyzed, as the two surfaces of the larger mass had been rubbed down, and as thus a considerable portion of the exposed silicate would be mechanically removed, it would make the density correspondingly higher.

I regret that I had not more of this interesting meteorite at my command, in order to have determined more definitely and satisfactorily the character of the insoluble residue. I shall be glad to make a further investigation of this point if you will supply me with more material.

Very respectfully yours,
GEO. J. BRUSH.

After reading the above letter, Professor Whitney added some remarks on the form and locality of the meteoric iron analyzed by Professor Brush, stating the circumstances under which it came in possession of the city of San Francisco.

On the twenty-fourth of November, 1862, the Board of Supervisors of this city received, through Mayor Teschemacher, a letter from General George Wright, commanding the Department of the Pacific, stating that he had received a mass of meteoric iron from General Carleton, commanding the "Column from California," and which mass he, in accordance with General Carleton's request, placed at the disposal of the city authorities.

General Carleton's letter is here appended:

Head Quarters Column from California,
Tucson, Arizona, June 30th, 1862.

To General George Wright, *U. S. Army,*
Commander Dep. of the Pacific, San Francisco, Cal.

My dear General:—Soon after my arrival at this place I sent by a train to Fort Yuma, to be shipped to your address at San Francisco, a very large and beautiful Aerolite, which I found here and which I had heard and read of for many years. In *Bartlett's Explorations*, vol. 2, page 297, it is described as follows: "In the afternoon," July 18th, 1853, "I called to take leave of General Blanco, and at the same time examine a remarkable *meteorite*, which is used for an anvil in a blacksmith's shop. This mass resembles native iron, and weighs about six hundred pounds. Its greatest length is five feet. Its exterior is quite smooth, while the lower part which projects from the larger leg is very jagged and rough. It was found about twenty miles distant on the road towards Tubac and about eight miles from the road."

I desire that you present this aerolite to the City of San Francisco, to be placed upon the Plaza, there to remain for the inspection of the people and for examination by the youth of the city forever. It will be a durable memento of the march of the *Column from California.*

I am, General, sincerely and respectfully,

Your friend and servant,

JAMES H. CARLETON,
Brigadier General U. S. A.

Soon after this mass of meteoric iron came into the possession of the city, I obtained permission from the Board of Supervisors to have sawn from it a small piece for analysis and for distribution to a few of the principal public institutions in this country and Europe having collections of aerolites; this has been done, and also a fine photograph of it taken by Mr. C. E. Watkins, of which copies will be forwarded, with the specimens of the mass itself, as convenient opportunity offers.

The piece intended for analytical examination was sent to Professor Brush of Yale College, and a letter has just been received from him giving the results, which will be found in the preceding pages, and which may appropriately be followed by a few remarks on the size and general appearance of the mass, with such other facts in regard to it as may be of general interest:

The weight of the mass of which the analysis is given above was six hundred and thirty-two pounds, when it arrived in this city, and about two pounds have been since cut from it.

Its shape is irregular, but in general it is that of a flattened elongated slab, having a length of four feet one inch and an average breadth of about eighteen inches; its thickness is irregular, varying from two to five inches. It has evidently been long used as an anvil, having been partly buried in the ground in an upright position, having a flat face of about four inches square on the top, with two holes drilled in the projecting edge for adding to the convenience of its use as a blacksmith's anvil.

The mass is now placed in the Mayor's office, it having been deemed inadvisable to expose it on the Plaza, as desired by the donor, on account of its liability to rust in the damp atmosphere of San Francisco, and the difficulty of securing it from injury by careless or mischievous handling.

Professor Brush remarks that "the composition of this meteorite corresponds very closely with that of *another* meteoric iron from Tucson" discovered by Mr. Bartlett and analyzed by Professor J. Lawrence Smith. A comparison of the analyses of Professors Brush and Smith and a reference to Mr. Bartlett's work seem to render it highly probable, to say the least, that the two analyses were of pieces cut from the same mass.

In this connection I will add to General Carleton's quotation from Mr. Bartlett's book a few lines which complete what is said in regard to the meteorites seen by him at Tucson. Mr. Bartlett adds, after stating that the mass was found about twenty miles distant towards Tubac and about eight miles from the road, "where we were told are many larger masses. The annexed drawing gives the appearance of this singular mass. There is another large mass within the garrison grounds, of which I did not take a sketch. With much labor Dr. Webb broke off a fragment of this meteorite, for the purpose of analysis."

The wood cut which Mr. Bartlett gives of the meteoric iron, which he notices as having been used as an anvil, shows at once, as does also the description, that, contrary to General Carleton's idea, this mass and the one which is now in San Francisco, are not the same. The mass figured by Mr. Bartlett is of a very peculiar shape, well adapting it to use as a common blacksmith's anvil, as it has a broad, flat top, and is supported by two legs.

In the absence of evidence to the contrary, it is reasonable to suppose that the mass forwarded by General Carleton is the one spoken of by Mr. Bartlett as "another larger mass," and of which no drawing was made; while, on the other hand, a piece was taken for analysis. This piece is almost certainly the one analyzed by Dr. Smith, and hence the close agreement in the two analyses—this chemist, however, not having apparently made so complete a separation of the nickel as Prof. Brush has done. Still it is possible, of course, that different portions of the mass may differ slightly in composition.

NOTICE OF THE AINSA METEORIC IRON.

[From the Proceedings of the California Academy of Natural Sciences, Vol. III, page 48.]

Prof. Whitney read the following notice of the large mass of meteoric iron now in this city, on its way to the Smithsonian Institution:

By a singular coincidence, we have now the pleasure of seeing in this city the two great masses of meteoric iron which have been so often spoken of as being at Tucson, in Arizona, one of which was brought here and presented to the city by General Carleton, in November last, a notice of which, with an analysis, has already appeared in our proceedings. This mass may properly be designated as the " Carleton (Tucson) Meteoric Iron," while the one which is destined for the Smithsonian Institution may be called the "Ainsa (Tucson) Meteoric Iron," as it has been rendered accessible for scientific investigation by Mr. Jesus M. Ainsa, as will be seen by the following memorandum of the circumstance kindly furnished by his brother, Mr. James M. Ainsa :

" This ærolite was first discovered by the early Jesuit Missionaries in the mountains called the ' Sierra de la Madera,' near Tucson.

" In 1735, El Capitan de las Provincias del Occidente, Don Juan Bautista Anza, induced by the accounts of the science-loving Jesuits, ordered the aerolite to be removed from the mountains, with the intention of sending it to Spain. However, through the want of wagon roads and the proper means of conveyance at that time, to take it to San Blas, then the nearest port of entry, the attempt was entirely abandoned.

" The aerolite was left at Tucson, where it continued to attract the attention of the scientific men who visited that country for more than a hundred years. Since the acquisition of Arizona by the United States, greater notice has been taken of this aerolite, it having been mentioned several times in the official reports of the Government agents.

" By a singular coincidence, Augustin Ainsa, the great-grandson of Don Juan Bautista Anza, undertook, in 1860, to transport the aerolite and present it to the Smithsonian Institution. With great difficulty it was brought as far as the Yñigo hacienda, where it remained until May, 1863, when Jesus M. Ainsa, in his late visit to Sonora, brought it to this city, with the intention of forwarding it to the Smithsonian Institution at Washington, where it will soon be sent."

At present the mass in question lies upon the steps of the Custom House, where it has been most admirably photographed by Mr. Watkins.*

It was said by Mr. Ainsa to weigh 1,600 pounds.

The shape of this meteoric mass is very peculiar; and, at first, it would hardly be recognized as the identical specimen figured by Mr. Bartlett at Tucson, especially as this gentleman estimated its weight at 600 pounds only. Instead of being, as Mr. Bartlett supposed, a mass supported on two legs, it is, in reality, a ring of metal, of very irregular dimensions, of which about one-quarter was buried in the ground, in order to support it in a convenient position for use as an anvil, when it was seen by him at Tucson.

The dimensions of this ring are as follows:

Greatest exterior diameter	49	inches.
Least exterior diameter	38	"
Greatest width of central opening	26½	"
Least width of central opening	23	"
Greatest thickness at right angles to plane of ring	10	"
Width of thickest part of the ring	17½	"
Width of narrowest part	2¾	"

The weight of the mass corresponds, taking the specific gravity at 7.2, with a circle-ring, having an average width of one foot, and a thickness of a small fraction less than eight inches—the diameter of the circle represented by the exterior of the ring being assumed as four feet.

On examining with a magnifying glass a fractured surface of the mass, it was seen at once to be different in composition from the Carleton Meteoric Iron, and my conjecture that Prof. Smith was mistaken in supposing that he analyzed a fragment from the mass figured by Mr. Bartlett, was confirmed.† It is now almost certain that Messrs. Brush and Smith did analyze fragments of the same meteoric iron.

The Ainsa Meteoric Iron contains a large per centage of a white—almost transparent—silicious mineral, having a vitreous lustre, which may be olivine; but the amount seems larger than that in the Carleton mass. The Smithsonian Institution will undoubtedly cause a chemical investigation to be made of this superb meteoric mass, and it will be interesting to compare its composition with that of the Carleton meteorite, as the two were found so near each other that they may be supposed to have formed portions of the same body, and to have fallen at the same time.

The photograph was taken by Mr. Watkins, at my request, partly to be sent abroad as a specimen of the high degree of perfection which has been attained by this gentleman in this department of art, and partly that an exact representation might be secured of this very remarkable body, in case it should be lost or captured on its way to Washington.

---

*The mass was shipped on the Panama steamer, which sailed from San Francisco on the 3d of August.

† See page 34, of this volume.

In concluding this notice, the following statement is given of all that is known of the size and position of the masses of meteoric iron which have been noticed by various travelers in Arizona and the adjacent portions of Mexico and New Mexico.

In the Madera range, "Sierra de la Madera," between Tucson and Tubac, "enormous masses of pure iron, some of which were transported to Tucson, and for many years were to be seen in the Plaza of that Presidio." Francisco Velasco, in W. F. Nye's Translation of his work on Sonora, p. 146, published at San Francisco in 1861.—Two of these masses have been brought to this city, the one weighing 1,600, the other 632 pounds; the question arises, how many more are left in the Sierra Madera? To this, no answer can be given at present.

"At the *Hacienda de Concepcion,* on the road from Chihuahua to Rio Florida," a mass of meteoric iron estimated to weigh 3,853 ℔s.—Bartlett. The exact locality of this hacienda I have not been able to ascertain.

"*Ninety miles north-west of Santa Rosa,*" supposed to be the Santa Rosa in the province of Coahuila, in Mexico, lat. 28°, long. 101° 30′; Ass't A. Schott, of the Mexican Boundary Survey, reports a large number of masses of meteoric iron; see page 34, Part II, of Major Emory's Report. This statement needs confirmation.

"*Sancha Estate, some fifty or sixty miles from Santa Rosa, in the north of Coahuila.*" This is the locality of the mass of meteoric iron, weighing 252 pounds, and now in the collection of the Smithsonian Institution, figured, described and analyzed by Professor Smith; see Smithsonian Report for 1855, p. 154, and Silliman's Journal, (2) XIX, 160. Professor Smith says, "various accounts were given of the precise locality, but none seemed very satisfactory." It is not unlikely that this mass is from the same locality mentioned by Mr. Schott.

"*Near the South-western edge of the Balson de Mapimi, on the route to the Mines of Parral,* there is a meteorite, near the road, of not less than a ton weight;" on the authority of Mr. Weidner, of the mines of Freiberg, as stated by Professor Smith (Smithsonian Report for 1855, page 155), Mapimi is in lon. 103° 30′; lat. 25° 45′ nearly.

"*At the Hacienda of Venagas,* there was (1827) a piece of iron that would make a cylinder, one yard in length, with a diameter of ten inches." It was said to have been brought from the mountains near the Hacienda." Professor Smith, on the authority of Dr. Berlandier (Smithsonian Report for 1855, p. 155), makes the above statement; the exact locality of the Hacienda I have been unable to ascertain; it is probably nearly in lat. 24°, lon. 101°.

La Paz, New Mexico, near the Colorado River, about lat. 33° 30′. A mass of meteoric iron, weighing 10 pounds, was brought from that locality. in 1862, by Mr. H. Ehrenberg.

A number of other localities of meteoric iron might be added from more southern and central portions of Mexico; but as that is a region to which the attention of Californian explorers and capitalists has not yet been much directed, it will not be necessary to cite them here. It is hoped that the circulation of the above list may be the means of procuring further information in regard to the masses of iron noticed; and that, possibly, more of them may be brought to San Francisco.

THE LIBRARY OF THE
SEP 24 1930
UNIVERSITY OF ILLINOIS.

3 0112 072841403